

**Optical Coherence Tomography
Angiography Evaluation of Ocular
Changes in Patients With Carotid
Artery Stenosis**

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Optical Coherence Tomography Angiography

Evaluation of Ocular Changes in Patients With

Carotid Artery Stenosis

Relevant background and objective

A growing body of research indicates that abnormal ocular microvascular features may serve as a novel biomarker reflecting the severity of underlying cardiovascular, neurodegenerative, and microvascular disease. Since blood flow to the retina is predominantly supplied by the internal carotid artery (ICA), we hypothesized that ocular microvasculature and structure changes may reflect the disease status or therapeutic effects in patients with carotid artery stenosis.

Optical coherence tomography angiography (OCTA) is a novel, non-invasive imaging modality that can be a reliable tool for the qualitative and quantitative assessments of ocular vessels during various ocular pathological or physiological changes. Recent studies have also demonstrated the ability of OCTA to quantify retinal microvascular changes in monitoring cardiovascular risk.

This study aims to evaluate ocular changes in patients with carotid artery stenosis by optical coherence tomography angiography before and after carotid artery revascularization procedure. In this study, the patients with carotid artery stenosis and control group will receive a series of cerebral and ocular examinations including the most important cerebral CT perfusion (CTP) and OCTA. After that, the cerebral and ocular data between the two groups will be compared. Also, the preoperative and postoperative data acquired will be compared.

Study design and methods

This was an observational retrospective and propensity score-matched analysis study. It was approved by the Ethics Committee of our hospital.

We searched for a clinical database of patients with carotid artery stenosis in our hospital between November 2019 and February 2020. The patients were examined by digital subtraction angiography (DSA), and the degree of carotid artery stenosis was measured by the North American Symptomatic Carotid Endarterectomy Trial (NASCET). The degree of carotid artery stenosis was graded as mild (50-70%) and severe ($\geq 70\%$).

Besides, healthy individuals were selected from Physical Examination Centers in our hospital; these individuals were confirmed to have no carotid artery stenosis by bilateral carotid doppler ultrasound examination.

Information collected including visual acuity (VA), diopter measurement using automated optometry, intraocular pressure (IOP) measurement using a noncontact tonometer, slit-lamp biomicroscopy fundus examination, OCTA, and CTP(patients only). Each subject's medical history and family history were also recorded.

Interventional procedure

The patients in the experimental group were treated with carotid endarterectomy (CEA) or carotid artery stenting (CAS). Their surgical indications, surgical procedures and surgical norms all follow the AHA guidelines¹² and "Rutherford's Vascular Surgery"¹³

Follow-up assessments

All patients were asked to repeat OCTA and CTP examination on the 4th day after the operation before discharge. We also collected this information.

Statistical analysis

Categorical variables are presented as percentages, continuous variables are presented as mean \pm SD and skewed variables are presented as median (boundaries of interquartile range, IQR). A propensity score-matched(PSM) analysis was done using a multivariable logistic regression model based on age, gender, tobacco, alcohol, diabetes mellitus. Pairs of participants were derived using 1:1 greedy nearest neighbor matching. This strategy resulted in 31 matched pairs in each group.

Clinical characteristics between groups were compared using χ^2 test for categorical variables, paired t-test for normally distributed continuous variables, and Wilcoxon rank-sum tests for non-normally distributed continuous variables. Paired sample t-tests were used to assess preoperative to postoperative changes in OCTA variables.

Fisher exact probability method was used to verify p-value when 25% theoretical frequency was less than 5; all tests were bilateral tests, and there was statistical significance when $p < 0.05$. All statistical analyses were performed using SPSS Statistics software (v25, IBM, Armonk, NY, USA), whereas graphs were generated using Prism 7 (v7.02, GraphPad, La Jolla, CA, USA).